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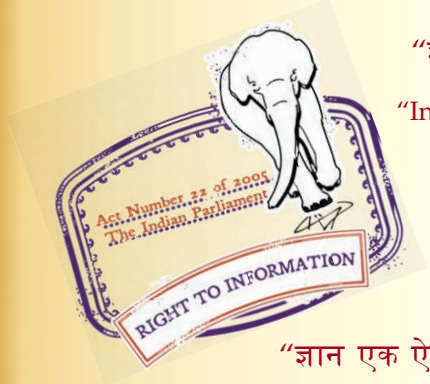
IS 11561 (1986): Code of Practice for Testing of Water Cooling Towers [MED 3: Refrigeration and Air Conditioning]



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Refrigeration and Air Conditioning Sectional Committee, EDC 66; Air Conditioning and Refrigeration Equipment (Central Plants) Subcommittee, EDC 66:2 [Ref:Doc:EDC 66 (4323)]

Indian Standard

CODE OF PRACTICE FOR TESTING OF WATER COOLING TOWERS

1. Scope — Describes a recommended code of practice for performance testing of water cooling towers.

2. Terminology — For the purpose of this standard, the following definitions shall apply.

2.1 *Cooling Tower* — It is a steady flow device that uses a combination of mass and energy transfer to cool water by exposing it as an extended surface to atmosphere.

The water surface is extended by filling, which presents a film surface or creates drops due to splashing or by spraying which produced droplets.

2.2 *Air Flow* — Total quantity of air flowing through the cooling tower.

2.3 *Inlet Air Wet Bulb Temperature* — Average wet bulb temperature of the air at inlet to the cooling tower.

2.4 *Circulating Water Flow* — The quantity of hot water flowing into the cooling tower.

2.5 *Hot Water Temperature* — Temperature of circulating water entering the cooling tower.

2.6 *Recooled Water Temperature* — Temperature of circulating water leaving the cooling tower.

2.7 *Cooling Range* — Difference between the hot-water temperature and the recooled water temperature.

2.8 *Heat Load* — Rate of heat removal from the circulating water within the cooling tower.

2.9 *Approach* — Difference between the recooled water temperature and the inlet air wet bulb temperature.

2.10 *Drift Loss* — Water lost from the cooling tower as liquid droplets entrained in the outlet air.

2.11 *Purge* — Water discharged from the system to control concentration of salts or other impurities in the circulating water.

2.12 *Make Up* — Water added to the circulating water system to replace water loss from the system by evaporation, drift, purge and leakage.

2.13 *Cold Water Basin* — A device underlying the tower to receive the cold water from the tower and direct its flow to the suction line or sump.

2.14 *Packing or Fill* — The material which forms the heat transfer surface within the tower and over which the water is distributed in its passage down the tower.

2.15 *Water Distribution* — The arrangement whereby the water is conveyed to all parts of the packing at the top of the tower.

2.16 *Casing or Cladding* — The facing material which surrounds the packing and retains the water within the tower.

2.17 *Tower Pumping Head* — The head of water required at the inlet to the tower measured above the basin kerb to deliver the circulating water through the distribution system.

2.18 *Fan Power* — The power input to the fan assembly excluding power losses in the driver.

2.19 *Fan Drive Assembly* — Components for providing power to the fan, normally comprising driver, drive shaft and transmission unit and primary supporting members.

3. Technical Guarantee

3.1 The object of the test procedure is to determine the overall operating characteristics of the cooling tower and to verify the technical guarantee as agreed between the purchaser and the supplier.

The guarantee shall cover functional and thermal performance of the cooling tower in terms of quantity of water, range approach and inlet air conditions within the conditions of validity specified in **5.**

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4. Conditions of Validity of Tests

4.0 In determining the performance and thermal efficiency of cooling towers, the following conditions of validity shall be fulfilled.

These conditions may also form the basis for contractual agreement between the purchaser and the supplier.

4.1 *Conditions of Equipment* — At the time of test all equipment and system shall be in proper operating condition and the following checks shall be made.

4.1.1 Water distribution system shall be clear and free irom foreign materials which may clog or impede normal water flow.

4.1.2 Mechanical equipment shall be in good working order and set for design duty.

4.1.3 Drift eliminators shall be clear and free from algae and other deposits which may impede normal air flow.

4.1.4 Packing shall be free from foreign material, such as oil, scale or algae.

4.1.5 Water level in water basin shall be at normal operating elevation immediately prior to the test.

4.1.6 Wherever possible the make-up and purge should be shut off during the test in the interest of simplicity and accuracy.

4.2 *Conditions of Atmosphere* — The test should be carried out during stable weather conditions with the following restrictions.

4.2.1 The average wind velocity shall not exceed 7·0 m/s when measured at a height of 1·5 to 2·0 m above local ground level.

4.2.2 The inlet wet bulb temperature should be within $\pm 5°C$ of the design wet bulb temperature. Readings may fluctuate but the rate of change in average wet bulb temperature shall not exceed 1°C/min.

4.3 *Variation from Design Conditions* — The following variations of average test readings from design conditions shall be permissible.

4.3.1 Circulating water flow not more than 10 percent above or 10 percent below the design value.

4.3.2 Cooling range not more than 20 percent below or 20 percent above design.

4.3.3 Heat load not more than 20 percent below or 20 percent above design.

During the hour selected as being representative of the test conditions, the dlfference between maximum and minimum readings of circulating water flow, cooling range and heat load, shall not exceed 5 percent.

5. Test Requirement

5.1 *Functional Test Requirements* — In order to establish that the cooling tower is fully operational and that the mechanical equipment is functional in accordance with the design requirements, checks should be made on the equipment described in **5.1.1**, **5.1.2** and **5.1.3** as follows.

5.1.1 *Fans*

a) The fan blades are angled for design duty,

b) The fan is centralized in the fan housing to ensure uniform tip clearance within the specified tolerances,

c) The fan rotates in the correct plane, and

d) The direction of rotation of the fan is correct.

5.1.2 *Fan drive assembly*

a) The fan drive is aligned within the specified tolerances,

b) The lubrication is in accordance with the manufacturer's recommendations,

c) The fan power observed under no heat load conditions is within the capacity of the driver, and

d) There is no excessive mechanical noise or vibrations.

5.1.3 *Water distribution system*

a) All the valves are operating freely,

b) The system is regulated for even distribution, and

c) The water levels are correct with sufficient free board.

5.2 *Performance Test Requirements*

5.2.1 *Thermal performance tests* — To conduct a full thermal performance test, it is necessary to take readings of the following quantities:

Parameter	*Unit*
a) Wind velocity	m/s
b) Wet bulb temperature	°C
c) Dry bulb temperature	°C
d) Hot water temperature	°C
e) Recooled water temperature	°C
f) Circulating water flow	m^3/s
g) Make-up water quantity and temperature	m^3/s and °C
h) Purge water quantity and temperature	m^3/s and °C

5.2.2 *Power consumption*

5.2.2.1 *Pumping head* — It is to be checked that total head at the tower inlet is correct for design conditions.

5.2.2.2 *Fan power* — It is to be checked that the fan power is in agreement with that quoted for design.

5.2.3 *Amenities* — In the event of the test involving contractual obligations, covered by guarantee, observations may be required of the following:

a) Tower noise, and

b) Drift nuisance.

6. Instruments and Methods of Measurement

6.1 *Measurement of Wind Velocity* — The instrument recommended for the measurement of wind velocity is a rotating vane type anemometer.

Calibration of the instrument before use is necessary. Measurement shall be made in an open and unobstructed location to the windward side of the equipment at a horizontal distance sufficient to eliminate the influence of the upstream effects of the equipment and a vertical distance 1·5 to 2·0 m above local ground level.

The frequency of readings taken should increase with wind speed and gust effect, in order to arrive at a representative average result.

6.2 *Temperature Measurement*

6.2.1 *Measurement of air temperature* — The inlet wet bulb temperature shall be determined as the arithmetical average of measurements taken within 1·5 m of air inlets and between 1·5 and 2·0 m above the basin kerb elevation on both sides of the cooling tower, so as to bracket substantially the air flow to the tower.

The number of stations at which measurements should be taken depends upon the size of the cooling tower and the existence of neighbouring influences.

6.2.2 *Measurement of water temperature* — The location of the temperature measuring instrument shall be such that the true average temperature of the hot circulating water entering the distribution system of the cooling tower and the recooled circulating water entering the basin is determined. Make up and purge water temperature readings shall be taken in the piping immediately adjacent to the cooling tower.

6.2.3 *Temperature measuring instruments* — Temperature measurements shall be made with one or more of the following instruments:

a) Mercury-in-glass thermometers,

b) Thermocouples, and

c) Electric resistance thermometers.

The instrument accuracy shall be within $\pm$ 0·1°C.

In all measurement of wet-bulb temperature, sufficient wetting shall be provided and sufficient time shall be allowed for the state of evaporative equilibrium to be attained.

6.3 *Water Flow Measuring Instruments*

6.3.1 Volume measurements shall be made with either of the following instruments having an accuracy of $\pm$1 percent of the quantity measured:

a) Liquid quantity meter, measuring either mass or volume; and

b) Liquid-flow — rate meter.

6.3.2 Liquid quantity meter should employ a tank having sufficient capacity to accumulate the flow rate for at least 2 minutes.

6.4 *Measurement of Tower Pumping Head* — The following measurements shall be taken in order that the pumping head may be evaluated:

a) Static pressure above atmosphere measured at the centre line of the water inlet to the tower and immediately adjacent to the connecting flange.

b) The height above basin kerb level of the point at which the above static pressure is measured.

6.5 *Measurement of Power Input to the Fan* — The power consumption shall be the average power consumption in watts measured during head load test.

The power consumption shall not exceed by more than 5 percent of the value stated on the name-plate.

Electrical measurements shall be made with either indicating type or integrating type of instruments.

6.6 *Measurement of Drift Loss* — The amount of drift loss may be estimated by taking the difference between the quantity of make-up water flow and the sum of the purge flow and evaporation loss.

6.7 *Measurement of Tower Noise* — The total noise inclusive of the tower under full water and fan load shall be measured and also the background noise measured immediately before the test and exclusive of fan and water noise.

Noise level shall be measured by an industrial grade sound level meter on 'A' scale.

The microphone of the sound level meter shall be located out of doors, at least 1·5 m above local ground level and in position previously agreed between the purchaser and the supplier.

7. Evaluation of Results

The measure of the thermal performance of a cooling tower is its ability to fulfil guaranteed conditions in terms of quantity of water, range, approach and inlet air conditions.

This can be achieved by a direct comparison between the test results and the manufacturer's performance curves.

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